Measurement of Depth Resolved Thermal Properties in Turbid Media Using Differential Phase Optical Coherence Tomography

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Optical coherence tomography (OCT) has emerged as a promising technique for high resolution cross-sectional imaging of biological samples. Differential phase optical coherence tomography (DP-OCT) provides phase sensitive detection of the interference fringe intensity due to light backscattered from discrete locations in turbid media. DP-OCT has the potential of providing the sensitivity required to detect thermophysical changes in turbid media such as biological materials on the nanometer length scale in response to absorption of incident laser radiation. In comparison to many conventional interferometric techniques, phase sensitivity of DP-OCT is orders of magnitude higher because environmentally-induced phase fluctuations in the interference fringe intensity are detected in a common mode manner. We present results of recent studies in our laboratory to image the depth-resolved thermal response of turbid media using DP-OCT. Depth-resolved optical path length changes in turbid media due to the combined effect of thermoelastic strain and temperature variation of refractive index are measured in response to absorption of pulsed laser radiation. Application of the methodology to thermophysical measurements and biomedical imaging problems are discussed.